The 2016 Horse Mackerel Updated Assessment

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FISHERIES/2016/SEP/SWG-DM/51 provides a full description of the current stock assessment model for the South African Horse Mackerel. This document provides the updated 2016 assessment results for a number of model variants.

The assessment models, as used in assessments and MP testing since 2014 assume q_{aut} = 0.75 and *h* = 0.75. These values were selected as they fall in the middle of the bounds defined by the original Reference Set. The 2016 assessment model is further extended to allow for better fits to the midwater CPUE data for 2014 and 2015 (which are particularly low). The model either assumes these low CPUE values are due to reduced fishing selectivity, or that extra mortality of fish occurred at the start of 2014. Thus

Variant 1) $q = q_1$ for years up to and including 2013

$q = q_2$ for years 2014 and 2015

Variant 2) Extra mortality occurs at the start of 2014 (numbers-at-age in 2014 reduced by an estimated additional proportion M^{extra}). This extra mortality is a once-off event.

Note Variant 0 refers to the Base Case model without any further extension to allow for a better fit to the low recent CPUE values.

Sensitivities

Both Variant 1) and Variant 2) are refitted to the data where the most recent (2015) observed midwater CPUE value is altered from 0.181 to 0.259.

RESULTS

Table 1a reports the results of the updated 2016 assessment for Variants 0, 1 and 2, with Table 1b showing sensitivity results where the CPUE(2015) value is altered to 0.259 from 0.181. Table 1c compares some key assessment statistics between the 2016, 2015 and 2014 baseline (i.e. Variant 0) and Variant 1 and 2 (for 2015 and 2016) assessments.

Figure 1 compares Variants 0, 1 and 2 model fits to the observed abundance indices. Figure 2 similarly compares the assessment model fits to the commercial midwater catch-at-length data, averaged over years. Figure 3 plots the stock-recruit residuals estimated for each model variant. Figure 4 plots the estimated spawning biomass trajectories in absolute terms (top) and as proportions of their unexploited equilibrium levels (bottom).

DISCUSSION

Variant 0 fails to fit to the most recent (2014 and 2015) CPUE data – see Figure 1. Both Variants 1 and 2 however produce reasonable fits to these recent CPUE values and result in similar total –lnL values (Table 1a). The implications for current spawning stock size are very different for these two models, with Variant 1 estimating current (2015) spawning biomass to be 69% of the carrying capacity, whereas Variant 2 estimates this value to be only some 18%. The implications of these two alternate models when projecting into the future will be substantial.

Table 1a: Summary of results for the 2016 updated assessment – results reported for Variant 0, Variant 1 and Variant 2. For all variants q_{aut} = 0.75 and *h* = 0.75. The first numbers shown are the best estimates, while the figures in parentheses are the Hessian-based CVs. "SR" and "CAL" refer to stock-recruitment and catch-at-length respectively. Biomass is reported in units of kilo tonnes.

	Variant 0 No adjustments to take account of low recent CPUE	Variant 1 $q = q_2$ for 2014 and 2015	Variant 2 Extra proportion M^{extra} die at start of 2014
-ln L :Total	-224.51	-231.34	-230.92
-ln L :Spr survey	0.873	0.906	0.939
-ln L :Aut survey	-9.10	-9.77	-7.53
-ln L :CPUE	-0.84	-7.17	-10.01
-ln L :CAL Spr survey	-46.38	-46.13	-45.03
-ln L :CAL Aut survey	-87.68	-87.70	-87.09
-ln L :CAL commercial	-65.73	-65.88	-66.02
-ln L :SR residuals	-15.66	-15.59	-16.18
K^{sp} (KT)	806	812	857
B^{sp}_{2015} (KT)	**535**	**561**	**155**
$MSYL^{sp}$ (KT)	200	201	212
MSY (KT)	60	61	64
B^{sp}_{2015}/K^{sp}	**0.663**	**0.692**	**0.181**
$B^{sp}_{2015}/MSYL^{sp}$	2.677	2.789	0.730
$MSYL^{sp}/K^{sp}$	0.248	0.248	0.247
q: Spr survey	0.760	0.773	0.729
q: CPUE (x10^{-6})	1.531	1.521	1.742
σ: Additional Spr survey	0.660	0.663	0.665
σ: Additional Aut survey	0.289	0.273	0.342
σ: CPUE	0.569	0.349	0.280
σ: CAL Spr survey	0.096	0.097	0.101
σ: CAL Aut survey	0.151	0.151	0.152
σ: CAL commercial	0.107	0.106	0.106
q_2 (applies to 2014-2015)	-	0.282*q_{CPUE}	-
M^{extra} (once-off extra proportion die in 2014)	-	-	0.256

Table 1b: Summary of results for the 2016 updated Variant 1 and 2 assessments where the sensitivity to the observed 2015 CPUE of 0.259 (not 0.181) is examined. The first numbers shown are the best estimates, while the figures in parentheses are the Hessian-based CVs. "SR" and "CAL" refer to stock-recruitment and catch-at-length respectively. Biomass is reported in units of kilo tonnes.

	Variant 1 CPUE(2015)=0.181	Variant 1 CPUE(2015)=**0.259**	Variant 2 CPUE(2015)=0.181	Variant 2 CPUE(2015)=**0.259**
-ln L :Total	-231.34	-112.07	-230.92	-108.11
-ln L :CPUE	-7.17	-1.68	-10.01	-9.00
-ln L :CAL commercial	-65.88	-18.36	-66.02	-18.36
-ln L :SR residuals	-15.59	-15.93	-16.18	-15.92
K^{sp} (KT)	812	708	857	708
B^{sp}_{2015} (KT)	**561**	**542**	**155**	**148**
$MSYL^{sp}$ (KT)	201	184	212	184
MSY (KT)	61	96	64	96
B^{sp}_{2015}/K^{sp}	**0.692**	**0.766**	**0.181**	**0.209**
$B^{sp}_{2015}/MSYL^{sp}$	2.789	2.946	0.730	0.804
$MSYL^{sp}/K^{sp}$	0.248	0.260	0.247	0.260
q_2 (applies to 2014-2015)	0.282*q_{CPUE}	0.100*q_{CPUE}	-	-
M^{extra} (once-off extra proportion die in 2014)	-	-	0.256	0.291

Table 1c: Comparison between 2014, 2015 and updated 2016 RC assessment. [Note RC refers to a *q*_2 of 0.75 and *h* = 0.75]. Results are also compared between the 2015 and 2016 Variant 1 and 2 models where for Variant 1 the reduced *q* applies to 2014 only for the 2015 assessment and to 2014 and 2015 for the 2016 assessment. The Variant 2 extra mortality applies as a once off event in 2014 for both the 2015 and 2016 assessments. Biomass is reported in units of kilo tonnes

	Variant 0			**Variant 1 (reduced recent *q*)**		**Variant 2 (extra mortality in 2014)**	
	2014 assessment	**2015 assessment**	**2016 assessment**	**2015 assessment**	**2016 assessment**	**2015 assessment**	**2016 assessment**
K	835	813	806	813	812	908	857
*q*_1	0.76	0.78	0.76	0.78	0.77	0.73	0.73
MSY	63	62	60	61	61	69	64
B^{sp}_{2014}/K^{sp}	-	0.68	0.68	0.68	0.69	0.06	0.19
B^{sp}_{2015}/K^{sp}	-	0.67	0.66	0.67	0.69	0.05	0.18
-lnL	-221.69*	-213.57*	-224.51	-213.57	-231.34	-216.15	-230.92

*The –lnL values not strictly comparable due to increasing length of data series over time.

Figure 1: Assessment model fits to the abundance indices.

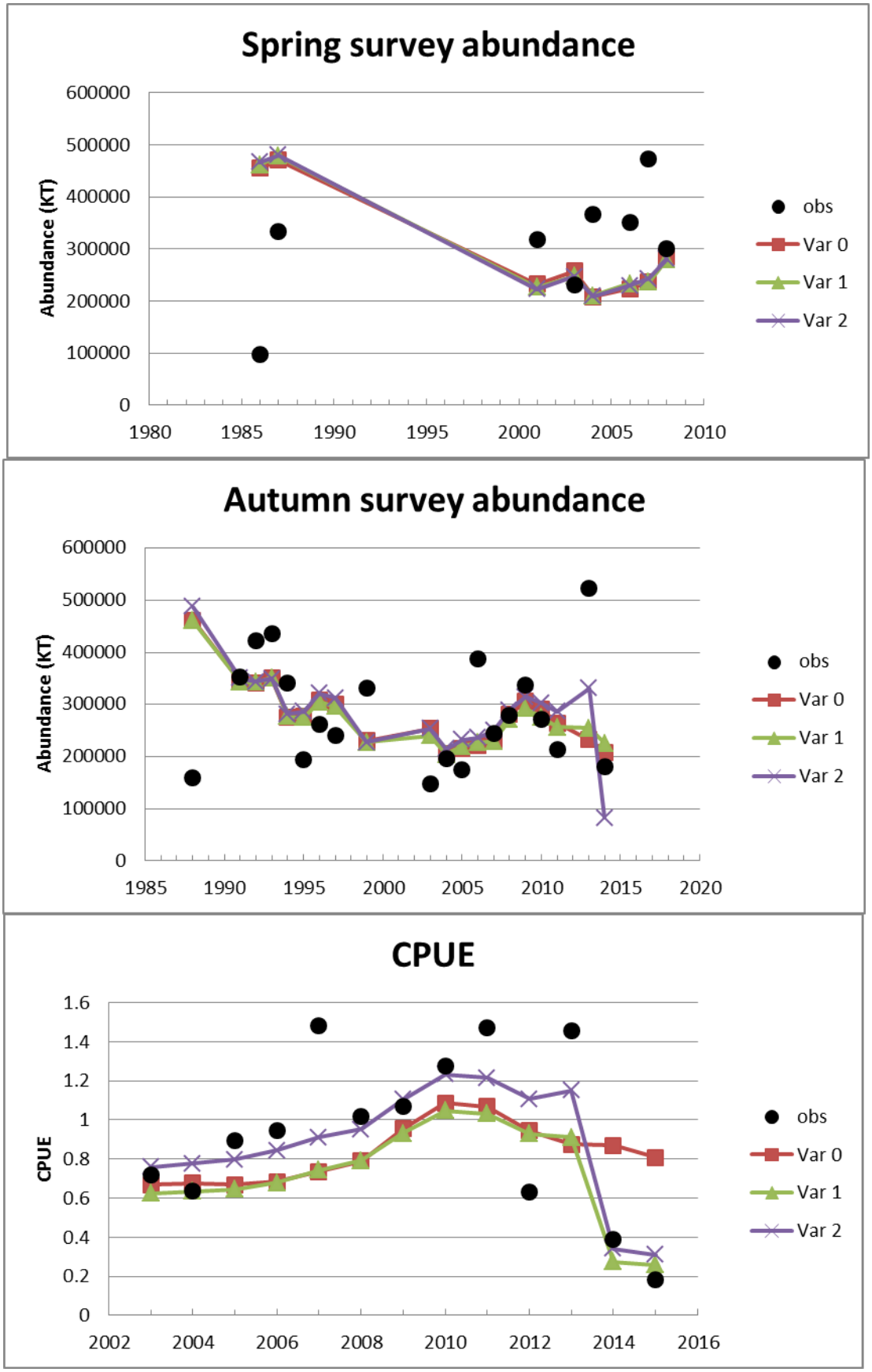

Figure 2: Assessment model fits to the commercial midwater catch-at-length data, averaged over years.

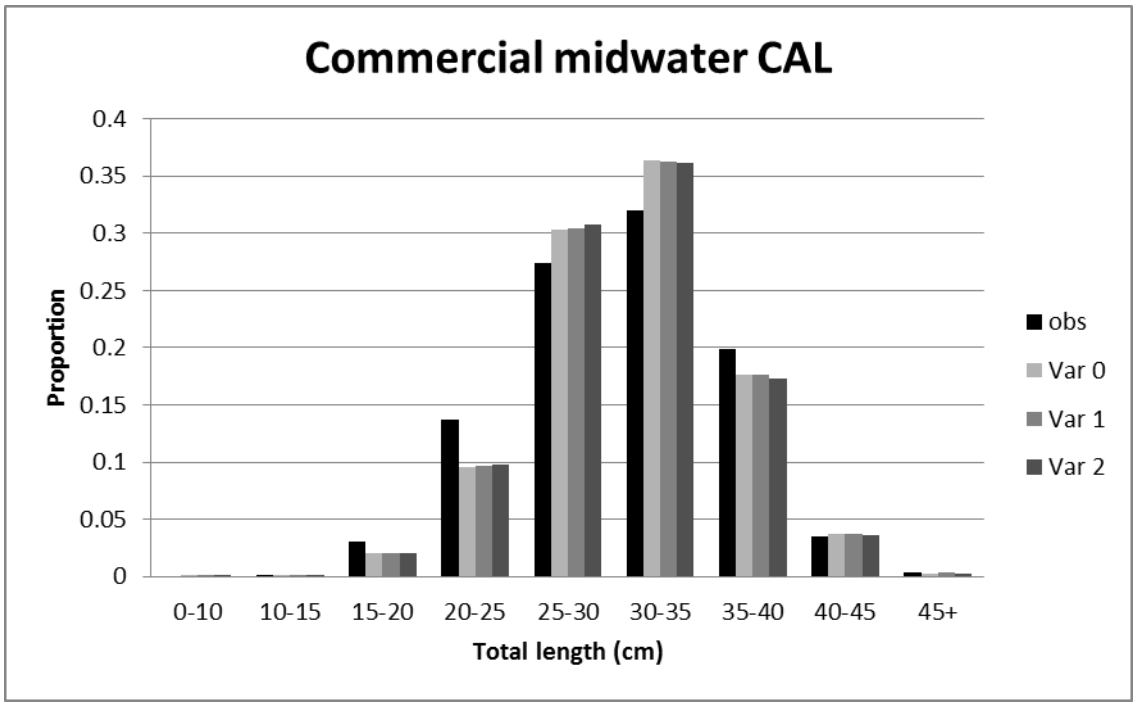

Figure 3: Estimated Stock-recruit residuals.

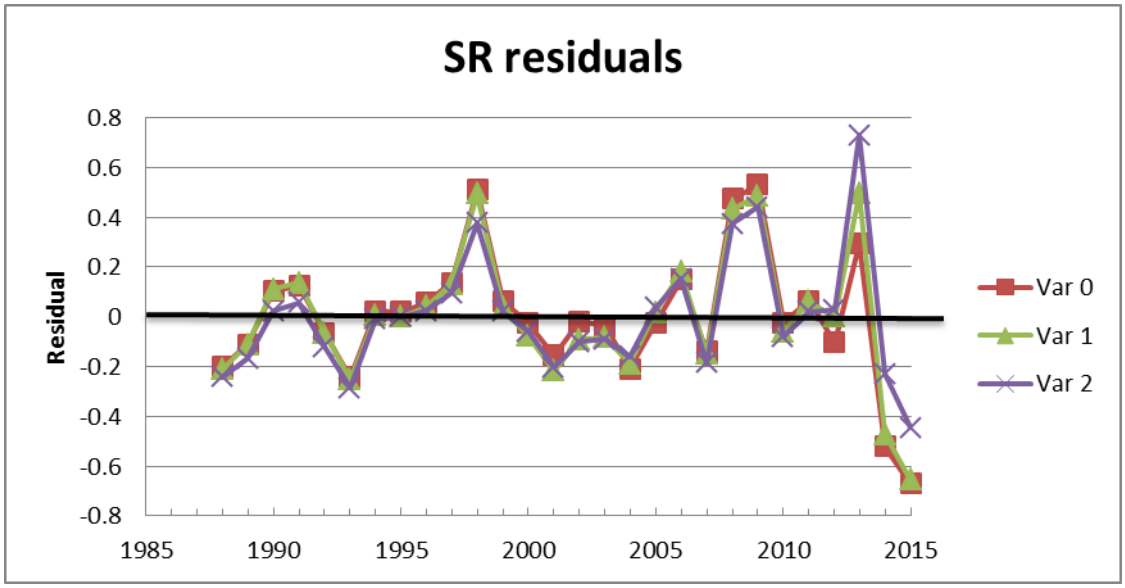

Figure 4: Estimated spawning biomass trajectories in absolute terms (top) and as proportions of their unexploited equilibrium levels (bottom).